

# Discussion on the Key Links in the Process of Building Material Quality Inspection and Testing

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**Abstract.** With the development of the construction industry, the applied building materials are becoming more and more diversified. As we all know, the performance and quality of the building materials themselves will have a direct impact on the quality of the construction project, which is related to the usability and safety of the construction project. If the quality of building materials cannot be inspected effectively, the probability of safety accidents in construction projects will be greatly increased, which will seriously threaten people's lives and property. This article analyzes the development process of building material testing and testing, and on the basis of summarizing the importance of building material testing and testing, it analyzes several key aspects of building material testing and testing.

**Keywords:** Building materials; Testing; Inspection.

## 1 Overview of the development of building materials testing and testing

Architecture is the basic construction of our human society and the most basic needs of people's lives[1]. It is related to people's safe accommodation, production, work, entertainment and rest. With the rapid economic development and the general improvement of living standards, people's requirements for building quality are becoming more and more stringent. The quality of construction involves many factors, among which the most important and direct factor is construction materials. Therefore, inspection and testing of construction materials has become a key link in construction engineering. Compared with the United States, Japan and other developed countries, my country's construction engineering quality inspection started late[2]. Although my country's investment in construction engineering has increased year by year since the reform and opening up, there are still single inspection items, unreasonable inspection sampling, and automated equipment. Problems such as low level and insufficient allocation of professionals are as follows:

The current testing and testing of building materials mainly involves the development of different testing and testing methods based on the physical and chemical properties of the materials. In the specific testing process, in order to ensure the effectiveness of the standardized test results of the quality testing process, it is necessary to conduct a comprehensive test on the function and type of the material[3]. Cement is a common building material and has a wide range of uses in construction. The testing

and testing of cement usually include specific gravity and bulk density, fineness and strength, setting time and stability. Different types of cement have different quality standards. If the test items are too single, accurate quality reports cannot be generated. The quality of buildings built on this basis is even more unsafe.

The testing of building materials includes the steps of sampling, sending samples, and witnessing. If the quality of the materials on site is unqualified after inspection, it should be banned immediately upon discovery[4]. Among them, sampling is the process of extracting experimental samples from the inspection objects in accordance with the relevant technical standards and specifications. If the sampling of on-site materials is unreasonable, it is likely to cause missed inspections or re-examinations. The report will not faithfully reflect the quality of building materials, and will increase the cost of testing and cause unnecessary waste of resources.

In all kinds of building construction, the low degree of automation of building materials detection is a common problem[5]. At present, the quality evaluation system of building materials in my country's construction industry is not perfect. In the testing of building materials, many testing items must be completed manually. Compared with the large-scale use of machines for detection, manual detection has problems such as low efficiency and high error rate, which causes deviations in detection results.

The testing technology of building materials involves building materials production, engineering construction, material research and development, quality control and commercial trade. Building materials testing is essential in building construction. Therefore, there is a high

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demand for technical testing personnel with high professional quality. However, the current construction industry has the problem of matching high-level professionals with job requirements[6]. The insufficient allocation of inspectors engaged in relevant inspection institutions, quality management personnel, and researchers from construction scientific research units makes the inspection effect impossible to guarantee.

In addition, the testing and testing of building materials still have problems such as non-standard testing technology and imperfect supervision system, which have brought great safety risks to the quality of construction projects.

## 2 Solutions to existing problems in building material testing

### 2.1 Material sampling

The material performance test report is obtained by testing the material samples taken. A representative sampling of test materials is essential. Sampling is generally based on randomly selecting a specified number of samples from different parts of a batch of materials, that is, not only the sampling quantity must be correct[7]. The sampling location and method should also be carried out in accordance with regulations. The number of samples is related to the accuracy of the test results. If sampling is not carried out in accordance with the specified sampling method, sampling location and sampling amount, or the sampling situation is deviated from the requirements, it may lead to deviations in the test data, which will adversely affect the quality inspection of the entire material. When receiving the test samples, the staff must do a good job of the state of the samples, and the record must include whether the sample is abnormal or whether it deviates from the standard state described in the test process. The laboratory must first clarify that the preparations for sample inspection are in place, and carry out the preparatory work for sample inspection with reference to the opinions of the client. The laboratory shall specify and appropriate facilities in the quality documents to prevent the samples used for inspection from being damaged or deteriorated before storage, disposal or inspection. The storage conditions must meet the requirements, and sufficient safety measures must be taken to ensure that the samples are inspected. The condition is intact, thus ensuring the smooth development of inspection work. The flow chart of construction material quality inspection management system is shown in Figure 1.

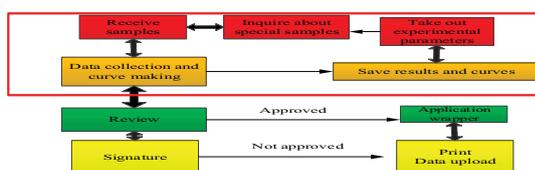


Figure 1. Flow chart of construction material quality inspection management system

What the data acquisition system needs to complete is the "test" step of the mechanical test in the construction material quality inspection management system. Simply put, obtain the detailed content of the commissioned test, perform the test, save the test result in the database, and return to the construction material quality inspection management system.

### 2.2 Staff quality

Testing agencies must standardize personnel and implement a qualification system. At present, there are a large number of employees in the testing industry, and it is quite difficult to regulate the quality of personnel[8]. It is recommended to further deepen the current training and assessment model of inspectors and implement a practicing qualification system. In addition, sufficient staff should be provided. The laboratory shall clearly stipulate the qualifications of the technical leader and the quality leader, and clearly stipulate the necessary qualifications for the senior and middle management personnel and the qualifications for the technical inspection personnel. It should also clearly specify the qualifications of the supervisory personnel for the verification audit. Qualifications and conditions of the position, and regular training, assessment and recognition. The system function block diagram of data acquisition system is shown in Figure 2.

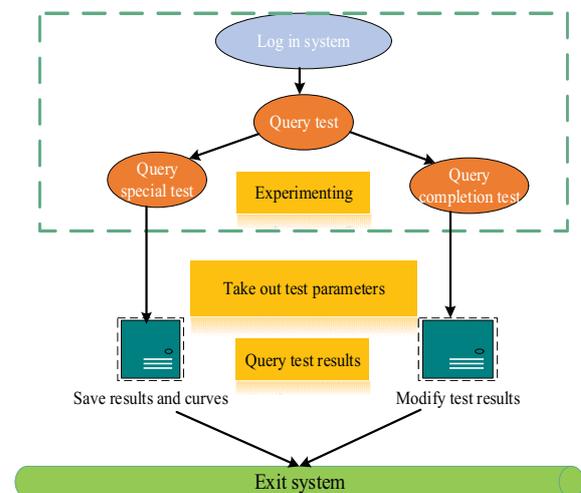


Figure 2. System function block diagram of data acquisition system

### 2.3 Test environment

Temperature and humidity have a great influence on the performance of some building materials. Therefore, there are clear regulations on material maintenance and environmental conditions during testing in the standard. Only when these regulations are strictly followed can the test results be comparable[9]. Under normal temperature test conditions, if the material is applied for mechanical performance test faster, the deformation of the specimen lags behind the load on it, and the measured strength value will be higher than the inherent strength of the material. If

the loading speed is faster when measuring the yield point of the steel bar, the yield point value will increase. The bending resistance, compression resistance and loading speed of cement, concrete, brick and other specimens have an impact on the measurement results. Therefore, the loading speed should be operated in strict accordance with the material standards and operating regulations. The loading should be continuous and uniform. When the specimen begins to rapidly deform and approach failure, stop adjusting the throttle of the testing machine until the maximum load value of the specimen is measured.

## 2.4 Equipment

The laboratory should be properly equipped with all instruments and equipment (including reference materials) for testing. All instruments and equipment are maintained in a timely manner, and maintenance data processing procedures are in place[10]. The testing equipment must be verified and calibrated, and the instruments and equipment should be clearly marked to indicate their status. When the displayed result is suspicious or the verification indicates that there is a defect, it should be stopped immediately and clearly marked. The repaired instrument must be calibrated to prove that it has been restored before it can be used normally to ensure that the data is true, valid and without deviation. In the data acquisition system, after querying the test, double-click a row in the test list to query the test's collection results and modify the data. The modification process will be recorded in the database, and the modification can also be done at the same time. See the previous changes.

## 3 Building material quality inspection

The testing method is the technical instrument for the implementation of the inspection. It is an important resource for the laboratory to carry out inspection services and an indispensable process for the implementation of the inspection work. When the laboratory conducts testing or carries out other related business activities, such as sample preparation, extraction, disposal, storage and transmission; estimation of measurement uncertainty; analysis of inspection data, etc., the correct testing method must be selected according to the relevant testing specifications and workflow. Moreover, international or national general testing specifications and standards must be adopted, and they can be used in work practice only after they have been approved by the laboratory technology supervisor[11]. The standard methods should be traceable. If the testing method or work process adopted is not internationally or domestically regulated, the client's consent must be obtained before testing, and a valid document must be formed to ensure that the report is accepted by the user and the client, and form a valid document confirmed in writing. Update the standards in a timely manner.

### 3.1 Strengthen management of building materials inspection errors

In the process of testing the quality of building materials, the problem of testing errors is widespread. Therefore, in order to improve the quality of building materials testing, it is very necessary to analyze the causes of testing errors and formulate corresponding testing programs. The problems of material sampling, testing and human operation may cause errors in material testing. In particular, the impact of human operation problems is the most serious. Therefore, the professional capabilities of relevant testing personnel should be continuously strengthened to ensure the standardization of each testing process and avoid human factors affecting the quality of testing. The testing organization itself should increase investment and regularly update testing equipment to ensure the advanced nature of testing technology. Before testing building materials, the equipment should be debugged according to relevant regulations to ensure the accuracy of testing.

For strength values that are not specifically required, the rounding interval is 1N/mm, when the strength value is 200-1000N/mm, the rounding interval is 5N/mm, and the strength value is >1000N/mm, the rounding interval is 10N/mm[12]. In addition, the rule that no contract cannot be revised during the calculation process should also be followed. For example, the apparent density test of sand "Quality Standards and Inspection Methods of Sand for Ordinary Concrete" stipulates that two tests are required, but the apparent density value calculated each time should not be rounded up. The mantissa of the average value of the result can be rounded to 0, otherwise it will increase the influence of error transmission.

### 3.2 Establish a dynamic inspection quality evaluation system

Building materials testing agencies should establish a dynamic evaluation system for the quality of testing, and implement it in the testing work, discover the deficiencies in the testing work, so that the staff can effectively adjust the specific process of the testing work, and at the same time The job responsibilities of inspectors are strengthened to enhance the inspection quality of building materials, so as to ensure the quality of construction projects. In addition, it is necessary to solve the problems of the inspection environment, not only to optimize the inspection environment, but also to strengthen the inspection instruments. Maintenance, to ensure the standardization of equipment application and the scientific nature of the calibration process, to ensure the quality of testing.

Due to various reasons, the results of the test data in the same group of specimens are sometimes very discrete. In order to make the test results accurate, the standard stipulates that the test result data of some materials must be selected. For example, in the flexural test of the strength of cement mortar, when one of the three strength values exceeds 10% of the average value, this value needs to be eliminated, and the average value of the other two

measured strength values is used as the flexural strength result.

$$E(x) = \sum_{k=1}^n x_k P_k \quad (1)$$

$$D(x) = E[(x - E(x))^2] \quad (2)$$

If two of the measured values exceed  $\pm 10\%$  of the average value, the remaining one measured value will be used as the flexural strength result. If all three measured values exceed  $\pm 10\%$  of the average value, the test must be repeated. The experimental error value is shown in Figure 3. The calculation of the average strength of the compressive specimens of concrete and mortar has its own selection method. It should be noted that you must not simply add up the data to calculate the problem. The method of rounding off the calculated data is carried out in accordance with GB/T8170, and the mantissa shall be rounded to the nearest single or double method, and the number of digits shall be retained according to the standard. The test result data sometimes appears to be too high or too low than expected, the data in the same set of test pieces are very different, or the performance indicators of the same test piece are contradictory, etc., which requires serious treatment, find out the reason, and retest in time and reinspection.

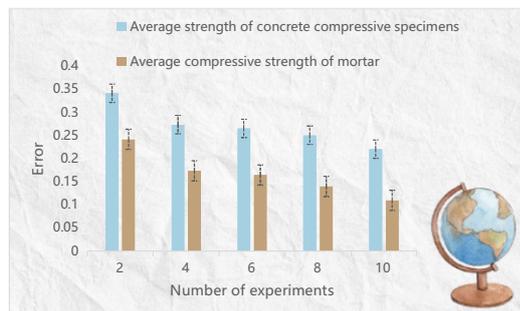


Figure 3. Experimental error value

## 4 Conclusion

Building material testing is an important link in the quality assurance system of construction projects. Building material testing plays an important role in the development of building materials research and technology, enterprise production and construction engineering construction. It is not only the basis and necessary means for assessing and controlling the quality of building materials It is also an important link for saving raw materials, developing building science and technology, and ensuring project quality. As professional and technical personnel in testing and testing, we must strengthen our own construction, strive to improve work responsibility, summarize experience and lessons in a timely manner, continuously enrich theoretical knowledge, and improve practical operations. We should also strengthen the professional ethics, integrity construction, and discipline of all personnel. A regular

assessment system for all types of personnel should be established and improved to ensure the accuracy of test results.

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